

THE
ALKALINE PERMANGANATES.

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ALKALINE PERMANGANATES,

AND

THEIR MEDICINAL USES.

BY

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“The activity of the body is made to depend, so far as we can yet see, almost wholly upon one process—the union of oxygen with its substance. An animal, physiologically considered, is mainly a great oxidizing apparatus. By the incessant performance of this process the living frame becomes full of power, which is manifested in the various modes familiar to our experience. The flame of life is a state of burning—a process rather than a thing. A flux maintained by forces from without, and ceasing when they are withdrawn;—that is our life.”—“On Health:” *Cornhill Magazine*, vol. iii., p. 337.



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PREFACE.

THE introduction of the Permanganate of Potash into the British Pharmacopœia has seemed, to the author of the following pages, to afford a favourable occasion for offering to the medical public, a few observations on the nature and therapeutical uses of the permanganate salts, which appear to him to be calculated, by their composition and properties, to supply an important want long felt in practical medicine, namely, non-deleterious substances possessed of the power of neutralizing those subtle poisons which, there are good

reasons for thinking, are the causes of the so-called zymotic and other such diseases. Whether the peculiar condition of the vital fluid, on which the diseases in question depend, be of the nature of zymosis or of catalysis, there can hardly now be much diversity of opinion as to the practical importance of regarding this class of affections as resulting from some form of blood poisoning,

Few inquirers have done more for the application to practice of this principle than the late Dr. Todd ; and before entering on the matter of the present essay, it cannot be amiss to place before the reader the admirable therapeutical maxims which that profound and philosophical practitioner laid down in one of his latest works.

“ 1. That the notion so long prevalent in the schools that acute disease can be prevented or cured by means which depress

and reduce vital and nervous power, is altogether fallacious.

“2. That acute disease is not curable by the direct influence of any kind of drug or any known remedial agent, *excepting when it is capable of acting as an antidote or of neutralizing a poison*, on the presence of which in the system the disease may depend (*materies morbi*).

“3. That disease is cured by natural processes, to promote which in their full vigour, vital power must be upheld. Remedies, whether in the shape of drugs, which exercise a special physiological influence on the system, or in whatever form, are useful only so far as they may excite, assist, or promote those natural curative processes.

“4. That it should be the aim of the physician (after he has sedulously studied the clinical history of disease, and made

himself master of its diagnosis) to inquire minutely into the intimate nature of these curative processes—their physiology, so to speak—to discover the best means of assisting them, *to search for antidotes to morbid poisons*, and to ascertain the best and most convenient methods of upholding vital power.”*

Although long known in scientific chemistry, and latterly in use by analytical chemists as oxidizing agents, the alkaline permanganates, until their introduction as disinfectants by Mr. Condy, of Battersea, were not even suspected of possessing any active properties which could be made available in any of the useful arts. Led by the study of the part played by ozone in natural disinfection to search for an efficient and true disinfectant among

* “Clinical Lectures on certain Acute Diseases,” by R. B. Todd, M.D. (1860), p. viii, Preface.

the unstable oxygen compounds, that gentleman was so fortunate as to find in the alkaline manganates and permanganates the agents he was in quest of. Those remarkable salts, in the crude state, and under the name of mineral chameleon, in the early days of popular chemical demonstration, were rarely omitted from the programme of the lecturer, who found in the striking changes of colour which they underwent from exposure to the air in solution, a useful aid in arresting the attention of his audience. On pouring a strong solution of manganate of potash into warm water, a liquid was produced of an intensely emerald-green colour, which, when allowed to stand, gradually acquired a brilliant blue tint; and by further exposure, passed successively through stages of purple, crimson, and brown; and after depositing a dark precipitate, became colourless. The

changes of composition which occasioned those alterations of colour were minutely examined by Forchhammer, Frommherz, Unverdorben, and others, whose labours completely elucidated the constitution of the manganic and permanganic acids. The alkaline combinations of the latter thereafter came into occasional use in the laboratory as powerful oxidizing agents. Permanganate of Potash is now employed for the detection of sulphurous acid in officinal hydrochloric acid, and of the inferior oxides of nitrogen in nitric acid. It is likewise used for the determination of iron, and other purposes in volumetric analysis.

In the course of his researches, Schönbein threw further light on the nature of permanganic acid, by identifying the surplus oxygen of that compound with ozone. He found that the oxygen given off in the

nascent state from permanganic acid had the reactions of ozone, while ozone had the power of converting peroxide of manganese into red permanganic acid.

Notwithstanding the amount of knowledge which existed on the subject of the permanganates, and their well known susceptibility to be decomposed by oxidisable matters of all kinds, there seemed, previous to the bringing out, in the year 1856, of Condyl's Fluid, which is a concentrated solution of those salts, to be little chance of their becoming of use in medicine. Mr. George Sampson, of Eaton-place, had indeed, as early as 1853, prescribed permanganate of potash in diabetes, with the view, hypothetically, of furnishing such an additional supply of oxygen to the food as should advance the chemical transformation of amylaceous matter beyond that of glucose, into the stage of acid metamor-

phosis. The effects expected were not, however, realized. On the contrary, the nascent oxygen of the permanganate in question was found by other experimenters to facilitate the formation of diabetic sugar.

Within the last four or five years the general use of Condyl's permanganate solutions as disinfectants has afforded the medical profession the opportunity of becoming familiar with the properties of those substances, which previously were not procurable without some difficulty. Extraordinary power in neutralizing the deleterious products of putrefaction, co-existing with an extremely innoxious character, soon led to their employment in the form of lotions in many surgical cases. The results obtained proving extremely satisfactory served further to suggest the trial of their effects as internal remedies, in cases where there

seemed to be present in the system some morbid product which required neutralizing. It is to the favourable issue of those experiments, coupled with the practical improvements in the manufacture of the entire series of permanganate salts which Mr. Condry has made, and for which he was awarded a prize medal at the International Exhibition of 1862, that is due the introduction of the Permanganate of Potash into the British Pharmacopœia.

THE ALKALINE PERMANGANATES.

It is neither an unscientific nor an un-instructive view of disease to look upon it in accordance with the teaching of a popular writer,* as depending on a partial arrest of the processes by which the renewal of the body is effected. Imperfect renovation of the tissues renders useless for a time some of the constituents of the blood, which thus becomes insufficient for the full development of life in every part of the system, and relapses into an inferior organic form unsuited for carrying on the work of the various organs. The grand agents by which the full renewal of the frame is accomplished are, on the one hand

* "Food, Medicine, or Poison : " *Blackwood's Magazine*, May, 1862.

food, and on the other oxygen. These two indispensable aliments, meeting in due balance in the blood, constitute the reservoir from which all bodily substances and vital forces are derived. The mechanism of the circulatory system furnishes the means by which the oxidizable mass of the blood is brought within the chemical influence of oxygen, and at the same time distributed to every part of the body. But the circulation of the blood itself is subsidiary to what may almost be styled the circulation of oxygen ; and it is not improbable that the time is not far distant when the due recognition of the importance of the circle of chemical changes which are unceasingly taking place in the body will be considered as an equally important discovery, though made more gradually, and by the co-operation of a great number of labourers, with that of the mechanical

movement which is as uninterruptedly going on in the vascular system.*

It is not only by the lungs and skin that oxygen is supplied to the system ; that substance is also largely provided in the food, from certain kinds of which the respiratory organs have the power of obtaining it, when the supplies furnished through the lungs are inadequate to the due oxidation of the sanguineous food. The amount of oxygen appropriated by respiration is relative to the quantity of food consumed. When the food taken is in excess of the respiratory function, or the wants of the system, and no escape is found for the superabundant matter, the effects of incomplete oxidation are produced ; the process of fibrination is retarded, and the disintegrated tissues, instead of having

* "Animal Chemistry," by Henry Bence Jones, M.D., p. 310.

their hydrocarbonaceous elements thrown off by the lungs in the shape of carbonic acid and water, their nitrogenized, sulphurized, and phosphorized constituents by the kidneys, as urea, nitric acid, sulphates, phosphates, and so forth, accumulate in the blood, and impregnate it with ammonia and various intermediate products of oxidation, such as uric and lactic acids, kreatinin, allantoic, cystic oxide, &c., as well as with numerous ill-defined offensive organic matters, which have been compared to the soot and empyreumatic substances generated by the combustion of a lamp or furnace insufficiently supplied with air. Stadeler's discovery in the urine of the cow, of an acid identical in composition with the carbolic acid of coal and smoke, forms a curious confirmation of this analogy. Circumstances which diminish the respiration,—as, for instance, warmth

of weather or climate tend to promote this accumulation of effete matters in the system. These effects may be classed together as referrible to deficient constructive metamorphosis, and ranked as parallel to those which are occasioned by prolonged nervous or muscular exertion, especially when accompanied by insufficient diet, and which are results of imperfect destructive metamorphosis, as well as to the effects caused by arrest or derangement of the functions of one or other of the excretory organs.

On the other hand, as the relative proportion of oxygen absorbed and carbonic acid exhaled does not vary with the quantity, although it does materially with the quality, of the food, it follows that the respiration during fasting is kept up at the expense of the constituents of the body itself, and that under this condition oxida-

tion of the animal tissues proceeds at an accelerated rate. This is what takes place naturally when morbid products are generated in the system by the operation of disease, or communicated direct by infection. Oxidation is relatively increased by the diminution of the consumption of food consequent on the failure of the appetite, and the attendant lassitude disposing to rest, which are the first effects and most uniform symptoms of derangement of the health. It may thus be said that oxygen is the great natural remedy called into play for combating disease. In all spontaneous cures it is the only substance which is employed by nature. The disordered system, when left to recover by itself, has no other agent at command, except food, which, in greater or less quantities, must be supposed to be taken, by means of which to effect an alteration

of its conditions; and just as the hepatic products are regulated, the urinary and other excretory matters eliminated, and the general metamorphosis of the tissues effected in the state of health by natural processes subservient to oxidation, so are the imperfect products of morbid action, by the agency of oxygen, consumed and carried off. As, for instance, in fevers and other diseases which in their intimate nature appear to be closely connected with the state of the blood, the abnormal conditions consist less in the entrance into the circulation of some specific poisonous material than in the communication of a peculiar state of transformation, it is hard to conceive in what other way, except by oxidation, the purification of a fluid so remarkably unstable and susceptible of intimate changes as the blood, could be brought about. This

is the reason why, in the treatment of the diseases in question, as well as in most others, measures calculated to promote freedom of respiration, as well of the eliminating functions of cutaneous and glandular excretion, are uniformly insisted on; for however necessary the latter processes may be to curative renovation, they are dependent on, and cannot fully take place without, adequate supplies of oxygen.

The remarkable inertness of oxygen in its ordinary state, as compared with its properties in the condition of ozone, leaves little room for doubt that, when absorbed into the blood, it is subject to some action of the nature of polarisation, by means of which it acquires a considerable increase of activity. As electrical discharges, constantly recurring in the atmosphere, are found to effect the transformation of neutral into ozonic oxygen, it may not be unreason-

able to assume that the electrical currents of the body,* and the chemical interchanges which are continually taking place among the substances contained in the blood, may have the effect of exciting the energy of the oxygen appropriated during respiration. Without supposing some such super-induction of activity, it would be difficult to explain why alcohol, whose elements do not possess by themselves the power of combining with that substance at the temperature of the body, and of forming carbonic acid and water, should, under certain circumstances, acquire that property in the blood. This and similar chemical changes are, moreover, much facilitated by the state of transformation in which the circulating fluid exists.

That so preponderating, essential, and

* "Bois-Reymond's Animal Electricity," by Dr. H. Bence Jones.

potent an element as active oxygen should have been hardly at all hitherto employed in medicine, is not a little remarkable. It apparently required the discoveries recently made of the sensibly-powerful action exerted by oxygen in its peculiar condition of ozone on miasmatic and impure organic matter,* and the analogous nature of the nascent oxygen which is evolved during their decomposition from the salts of permanganic acid and the peroxyde of hydrogen, to direct attention to the important part this body is capable of playing as a remedial agent. The latter compound had at one time acquired considerable reputation in France as a topical detergent, but owing

* Professor George Wilson, "On some of the more Important Chemical Disinfectants," in *Pharmaceutical Journal*, vol. xii, p. 278; Dr. Hornridge, "On the Influence of Ozone on Organic Substances," *Medical Times and Gazette*, 7th April, 1861; Pickford, "On Hygiene," pars. 336 and 1083.

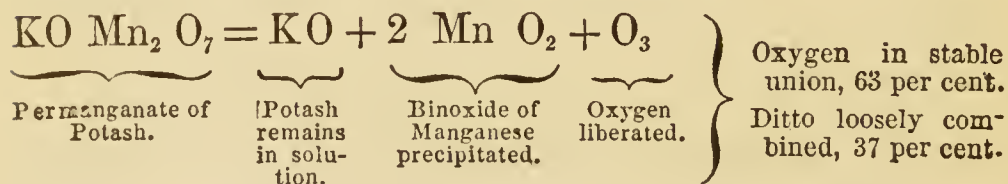
to the difficulty of making and keeping it, this preparation has not come into general use.* The able paper of Dr. B. W. Richardson, "On the Physiological and Therapeutical Properties of Peroxyde of Hydrogen,"† has done much to familiarize the profession in this country with the importance and variety of its medicinal uses. That gentleman's experiments possess very great interest, and are highly suggestive of some remarkable analogies between the effects of this substance and those of iodine and the salts of mercury, which are well deserving of further study.

The production of ozone, such as it occurs in nature, is not attainable by artificial means in a shape suitable for medicinal

* Dr. Ozanam, in *Comptes Rendus de l'Académie des Sciences*, vol. liii, p. 791 (Nov. 1861); *Chimie Industrielle*, par Payen, vol. i, p. 61.

† *Lancet*, Oct. 20, 1860, and April 12, 1862.

uses; but the researches of Schönbein, by demonstrating that permanganic acid is a true *ozonide*,* have shown that this substance is capable of communicating ozonic oxygen. In its combinations with alkaline bases, this highly oxygenated product forms salts in every respect adapted for medical purposes. These compounds are characterised by great instability of constitution; they consequently part readily with a portion of their oxygen to the extent of three equivalents out of the eight which, in the aggregate, enter into their composition, leaving five equivalents in stable union with manganese and potassium; thus:—



* *Handbook of Chemistry*, by Gmelin, vol. iv, p. 209, note.

Being in the nascent state when evolved, these three equivalents of this element, if not actually identical with ozone, exert at all events the same energetic action on all oxidizable organic matters,* and especially on those in a state of transition, such as animal secretions, exhalations, and miasmata.† From Schönbein's experiments it would appear that atmospheric air, containing so small a portion as $\frac{1}{3,240,000}$ of ozone, is capable of neutralizing its own volume of air loaded with the effluvia given off during one minute of time by a quarter of a pound of highly putrescent flesh. It may hence be inferred that the alkaline permanganates, whose recognised disinfecting action

* Houzeau "On Nascent Oxygen," *Comptes Rendus de l'Académie des Sciences*, t. xl, p. 947 (1855); t. xliii, p. 34 (1856).

† "On Ozone in relation to Health and Disease," by B. W. Richardson, M.D., *Popular Science Review*, No. 18, p. 33 (1866).

is so analogous to that of ozone, must, even in very minute doses, be of great efficacy in all cases in which there may be any putrescent tendency or septic condition to overcome, or any foul secretion to remove, as well as where the general effects or the chemical combination of oxygen are required.

Few compounds are so susceptible of decomposition by organic and certain other substances as the salts of permanganic acid. On this account it is necessary to be very guarded in prescribing them in combination. The following are the principal substances used in medicine with which the permanganates are incompatible :—

All organic bodies, tinctures, extracts, decoctions, infusions, medicated waters, syrups, confections, wines, unmedicated as well as medicated, hydrochloric acid, tartaric, citric, benzoic, gallic, and other or-

ganic acids (acetic excepted) and their salts, glycerine, the alkaloids and their combinations, iodine and iodides, arsenites and all metallic salts whose bases are capable of being converted into peroxides. The compatible substances are these:—Mineral acids (hydrochloric excepted), acetic acid, alkalies (including ammonia), clean alcohol, alkaline earths and their carbonates, almost all alkaline salts (borates and phosphates included), except tartrates and citrates, purified charcoal, and all metallic salts whose bases are not susceptible of peroxidation, such as nitrate of silver, sulphate of zinc, &c. In every instance in which the permanganates are prescribed in combination, it is important that the administration of the medicine should take place with as little delay as possible, since many substances which are compatible with them for prescription will, after a certain lapse of

time, effect their decomposition. In this category stand alcohol, ammonia, acetate of ammonia, &c.

Although remedies of an organic nature and other incompatible substances cannot be administered combined with a permanganate, their effects may be obtained when required, by alternating the exhibition of the two compounds, and giving the former half-an-hour or so after the latter. Even substances of such marked incompatibility as hydrochloric acid, which, on contact with permanganates, immediately evolves chlorine gas, may in this manner be prescribed at a short interval after those compounds. In many cases a precursory dose of permanganate would be found to enhance the action of other remedies, by removing from the stomach impurities previous to their administration.

The permanganates being compatible for

prescription with alcohol, their combinations with that substance must be of great use in enhancing its effects, by reason of the energetic action which they exert on putrescible matters. The operation of that stimulant, when administered on Dr. Todd's principle of supporting the system during renovation, will be effectually aided by the purifying agency of the permanganates.

In cases distinguished by hyper-alkalinity of the fluids, the compatible mineral acids may be prescribed in combination. By union with the alkaline base of the permanganate, these liberate permanganic acid, which has the utmost avidity for oxidizable substances, and restrain the transformation of nitrogenous products into ammonia.

Acetic acid will suggest itself for use in cases in which a grateful taste and refrigerent effect are wanted. Aërated waters

are very proper vehicles in such circumstances.*

The large proportion of oxygen contained in chlorate of potash points it out as a valuable adjuvant to the permanganates, when it is desired to introduce largely that element into the system. Although of comparatively stable constitution, and on that account disposed to pass unchanged through the circulation, this salt has been found by recent observations to be of use in communicating oxygen to the blood.†

The alkaline permanganates have been sufficiently used as internal remedies, especially since the introduction into the British Pharmacopœia of the Liq. Potass. Perman-

* Dr. Hillier, in *Medical Times and Gazette*, April 23, 1861.

† Dr. Fountain, "On Chlorate of Potash in Phthisis, and Oxygen and Ozone as Therapeutical Agents," *Medical Circular*, Dec. 8, 1860.

gan., to permit the following points to be considered as pretty well determined.

1. They can be taken in doses of from half a grain to two grains (equal to from one to two drams of the officinal Liq. Potass. Permangan.), often repeated, and continued during a lengthened period, without inconvenience.*

2. Acting physiologically, they diminish the frequency of the pulse, and to that extent aid the function of respiration. This effect is apparently owing to their supplying the system with oxygen, of which they contain so large a proportion.†

3. Acting chemically, they perform the part of purifiers of the blood, consuming morbid matters generated in the system

* *Lancet*, 1853, vol. i, p. 189.

† Dr. E. S. Thompson, "On the influence of ozonized substances on the Pulse," *Medical Times and Gazette*, 9th March, 1861.

itself or communicated from without, and thus second the renovating action of respiration. They likewise cleanse, by oxidation, the *primæ viæ* and the *ingesta*, and act as antidotes to morbid and putrescent excrementitious matters formed in the bowels, or discharged into them by the glandular apparatus, and to organic poisons taken into the stomach.

4. By reason of the facility with which they are decomposed and their base set free, the alkaline and earthy permanganates operate as antacids and alkalizers of the fluids of the body. These effects can be augmented by combining them with a further proportion of base, the nature of the alkali required regulating, of course, the particular permanganate salt to be chosen.

5. By the alkali, as well as the oxygen which they liberate by decomposition, those

salts tend to promote the diastasic transformation of starch and some of the other processes of digestion and chymification, especially aiding the assimilative function of the liver and the generation of hepatic glucogen, which constitutes the most appropriate pabulum of the calorifiant organs.*

6. As compounds of manganese, they produce the ordinary constitutional effects of this substance, which have conferred on it considerable reputation in the treatment of jaundice, hypochondriasis, torpid liver, and certain forms of dyspepsia. The muriate and sulphate of manganese have been much used by the German physicians in cases of cutaneous affections, syphilis, scorbutus, scrofula, chlorosis, cachectic complaints, and old ulcers. To the small quantity of the latter salt contained in

* Dr. Basham, in *Lancet*, vol. i, p. 97, 1854.

the mineral waters of Cransac have generally been attributed their peculiar virtues.

7. To whatever cause assignable, the alkaline permanganates must be admitted to possess the property of mitigating in a remarkable manner the thirst which is so severely felt in diabetes and most febrile diseases.*

8. After the permanganates have been repeatedly administered by the mouth in strong doses there will be observed on the tongue a brown deposit of binocide of manganese, which might readily be mistaken for the fur caused by febrile action, the colour of which it presents, but none of the other appearances.

The diseases belonging to the domain of medicine, as distinguished from that of

* Dr. Synnot, in *Medical Times and Gazette*, May 10, 1862; Dr. A. Prichard, in *British Medical Journal*, Nov. 1, 1862.

surgery, which present the most favourable conditions for the operation of the ozonic oxygen of the permanganates, are evidently those characterised by intestinal lesions, or accompanied by discharges from the bowels, such as dysentery, diarrhoea, and cholera ; those involving the nutritive functions, as, for instance, scrofula and tuberculosis ; and all affections referrible to contamination or degeneration of the blood, such as the continued and eruptive fevers, erysipelas, rheumatism, gout, scorbutus, syphilis, chlorosis, ichoræmia, leucocythemia, &c. What is already known of the properties of the permanganates would seem to justify the expectation that they will be found capable of neutralizing to a considerable extent those abnormal matters on the presence of which in the blood many of the above diseases appear to depend, as well as the gaseous products of

decomposition and low vitality which, by accumulation in the bowels, cause depression of the system.*

The relief obtained in certain forms of dyspepsia from full doses of Liq. Potass. Permangan. is strongly confirmatory of the advantage of Dr. Leared's treatment by peroxide of manganese. It remains to be proved whether the results furnished by the common black oxide are equal or superior to those produced by the higher oxide, from which, in the stomach, the hydrated binoxide in the nascent state is formed with evolution of free oxygen. The latter form, obtained from the precipitation of a permanganate salt, will be found particularly well-suited for prescription on Dr. Leared's plan. It ought

* "On the Alkaline Permanganates in Zymotic Diseases," *Medical Circular*, Jan. 21, 1862; Nevins' *Analysis of the Pharmacopœia*, p. 90 (1864).

to be preserved in the moist state, without being allowed to dry. This substance might be advantageously administered in Liq. Potass. Permangan.

Considering the part played by the cutaneous capillary vessels in the purification of the blood, and that performed by the nerves of the skin as the media of healthy stimulation to the nerve centres, as well as the practical importance of removing everything tending to diminish these functions, such as the presence of excreted and exhaled matters, there is much reason to expect effects of a most beneficial nature from the use of the permanganates in baths. The limited number of experiments which has been made with ozonised manganic baths leads to the conclusion that in them we possess a most powerful means of purifying the blood, and of aiding the cure of those affections which

are distinguished by a chronic state of vitiation of the system, as well as diseases of the zymotic class in which are present the symptoms of more acute blood poisoning. The peculiarly offensive character of the exhalations of lunatics,* and of the breath of hydrophobic patients, is highly suggestive of the advantage that might be derived from such ozonising measures.

The happy invention of M. Sales-Giron for obtaining, by a kind of pulverizing, liquids in a state of almost impalpable spray fit to be breathed, which has given rise to a great variety of instruments styled "atomisers,"† has provided a valuable method

* "Report on the Cork District Lunatic Asylum," by Dr. Power, in *Dublin Correspondence of the Times*, March 11th, 1861.

† The most generally useful instrument of this kind is "Condy's Atmospheric Ozoniser," sold by Barr and Co., 83, Fleet Street, London.

of inhaling the permanganates. There are many cases of lung disease, especially those attended by offensive sputa, in which the direct purifying action of spray ozonised with Liq. Potass. Permangan. would afford great relief, if not permanent benefit.*

Perhaps in no other disease is the remedial efficacy of the permanganates so manifest as in diphtheria. Their superiority over all other substances is due not only to their oxidizing power but also to the circumstance that the non-deleterious character of those salts permits of their being swallowed, and thus brought in contact with parts which cannot be reached by mere gargling. Their purifying action on the lower portion of the œsophagus and on the stomach, as well as their invigorating effects on the whole economy, conduce greatly to the overcoming of the con-

* Nevins' *Analysis of the Pharmacopœia*, p. 90.

ditions of body on which this dangerous and insidious disease depends. The remarkably satisfactory nature of the results obtained from the use of the permanganates in this affection, as well as in scarlatina, by Dr. C. Bell, to whom is due the merit of having originated the treatment, are deserving of the most serious attention on the part of the profession.* Inhalation by means of the "atomiser" would no doubt prove an extremely useful complementary measure.

Dr. Ozanam's observations on the effects of chemical re-agents on false membranes, point to combinations of the caustic alkalies with the permanganates, as of very great value in the treatment of diphtheritic sore throat.†

* "On Diphtheria," by Dr. C. Bell, *London Medical Review*, March, 1861.

† *Comptes Rendus de l'Académie des Sciences*, vol. lii, p. 74 (Jan. 1861).

Among the surgical diseases for which the alkaline permanganates are most suitable may be named the following:—cancerous, syphilitic, scorbutic, and strumous sores; bites of rabid and venomous animals; affections characterized by discharges, as ophthalmia, leucorrhœa, gonorrhœa, &c.; carbuncle, boils, and pustules; burns and suppurating surfaces in general; accidental wounds, and those from operations, particularly when there are present ligatures saturated with pus, or when gangrene is imminent; vesico-vaginal and other fistulas, hemorrhoids, and diseases of the uterus and rectum in general; difficult parturition where puerperal sepsis is to be feared.

In the present state of our knowledge we are, perhaps, unable satisfactorily to explain the pathological changes which give rise to the latter disease, or to

determine whether its occurrence is more intimately connected with morbid influences generated in the body of the sufferer, or with infection communicated from without. But whatever may be the origin of the affection in question, the nature of the virus developed is such as to render it particularly susceptible to the neutralizing action of ozonic oxygen. The alkaline permanganates would, therefore, seem to be well qualified for combating puerperal sepsis, since they admit of being used not only as agents exerting a general purifying action on the constitution, but as topical applications for the disinfection of the organs principally involved.*

It would be difficult to imagine sub-

* Dr. T. Skinner, in *British Medical Journal*, Dec. 8, 1859 ; Mr. J. White, in *Medical Times and Gazette*, Sept. 29, 1860 ; Mr. W. Haslewood, in *Medical Times and Gazette*, Dec. 1, 1860 ; Dr. A. Keiller, in *Edinburgh Medical Journal*, March, 1862, p. 890.

stances better calculated than the permanganates for the purposes of medical hygiene in preserving against certain contagious affections, such as venereal diseases, which are communicated only by immediate contact. As the blood is, perhaps, the least stable fluid which exists in nature, the secretions produced from it are extremely inclined for oxidation. With matters of this character the permanganates enter most rapidly into combination, and render them absolutely inoffensive. These effects are so prompt and certain that it might not be going too far to assert that the habitual and general use of those substances in ablutions by the two sexes would render inoculation almost impossible. The experiments made on this subject by M. Rodet, of Lyons,* with perchloride of iron,—a substance possessed of infinitely

* *Hygiène Publique*, par A. Rodet, Paris, 1861.

less neutralizing power than the permanganates, afford very strong reasons for expecting complete results from the latter salts.

In the treatment of some of the diseases of the skin, which are so usually connected with impurity of the blood or external uncleanness of the body, there exists a most extensive field for the use of the alkaline permanganates.

Those salts, in dilute solution, have also proved of great value in the treatment of burns and scalds of various degrees, as well as in cases of ulcers and suppurating surfaces, especially where secretions are not only copious but offensive. Besides deodorizing most effectually, they have been found, particularly in burns, to afford rapid alleviation of pain.*

In erysipelas, the application of solutions

* "Clinical Records," *Lancet*, Jan. 1, 1859.

of greater strength has been observed to arrest the disease even more effectually than nitrate of silver.

Judiciously used, the permanganates afford the means of greatly augmenting the curative influence of water, whether employed in the ordinary "water dressing," by prolonged immersion on Professor Hebra's plan,* or according to the system of Preissnitz and the hydropathists.

For ordinary external use, the officinal permanganate solution (Liq. Potass. Permangan.) when economy is no object, will be found well adapted. When a cheaper article is required for washing wounds, &c., Condyl's Fluid, which is in the hands of all as a disinfecting agent, can be employed; in cases requiring energetic stimulation or cauterization, the permanganate of potash in crystals may be taken. This salt in the

* *Medical Times and Gazette*, Dec. 12, 1861.

solid state gives the nearest approach to the effect of the actual cautery, since its action is of the nature of combustion by fire. It may be used with great advantage to promote the separation of sloughs* and as a caustic application to chancres and other foul sores.† For such purposes it will often be found most beneficial applied alternately with other caustics.

Combined in solution with nitrate of silver, sulphate of zinc, biborate of soda, and other such compatible salts commonly used in washes, injections, gargles, collyria, &c., the Liq. Potass. Permangan., by exerting an oxidizing and purifying action simultaneously with that of the substance associated with it, materially increases the effects of such applications.

* "On Cancer," by T. W. Cooke, p. 122 (1865).

† Mr. T. Weeden Cooke, at *Medical Society of London*, Oct. 21, 1859; Dr. G. F. Girdwood, in *Lancet*, Sept. 12, 1857.

In poultices, the alkaline permanganates are extremely useful. Although the reduction of the permanganic acid, which takes place almost at the instant the poultice is made, robs the compound of a large portion of free oxygen, the newly formed binoxide of manganese appears to retain a considerable amount of energy. To the water used in making the cataplasm must be added a certain quantity of permanganate solution, and a further portion poured on the surface of the poultice when about to be applied. When the chief object in view is to cleanse, the charcoal poultice saturated with *Liq. Potass. Permangan.* or *Condy's Fluid*, will be found invaluable.

A most useful ointment is made by rubbing up, shortly before use, from four to ten grains of crystals of permanganate of potash, with one ounce of "unguentum

simplex." The reduction of the permanganic acid of the salt proceeds much slower in this combination than in poultices.